PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B60R 21/16 — A1

(11) International Publication Number: WO 99/42333

(43) International Publication Date: 26 August 1999 (26.08.99)

(21) International Application Number: PCT/US99/00508

(22) International Filing Date: 8 January 1999 (08.01.99)

(30) Priority Data:
09/026,571 20 February 1998 (20.02.98) US

(71) Applicant: BREED AUTOMOTIVE TECHNOLOGY, INC. [US/US]; P.O. Box 33050, Lakeland, FL 33807–3050 (US).

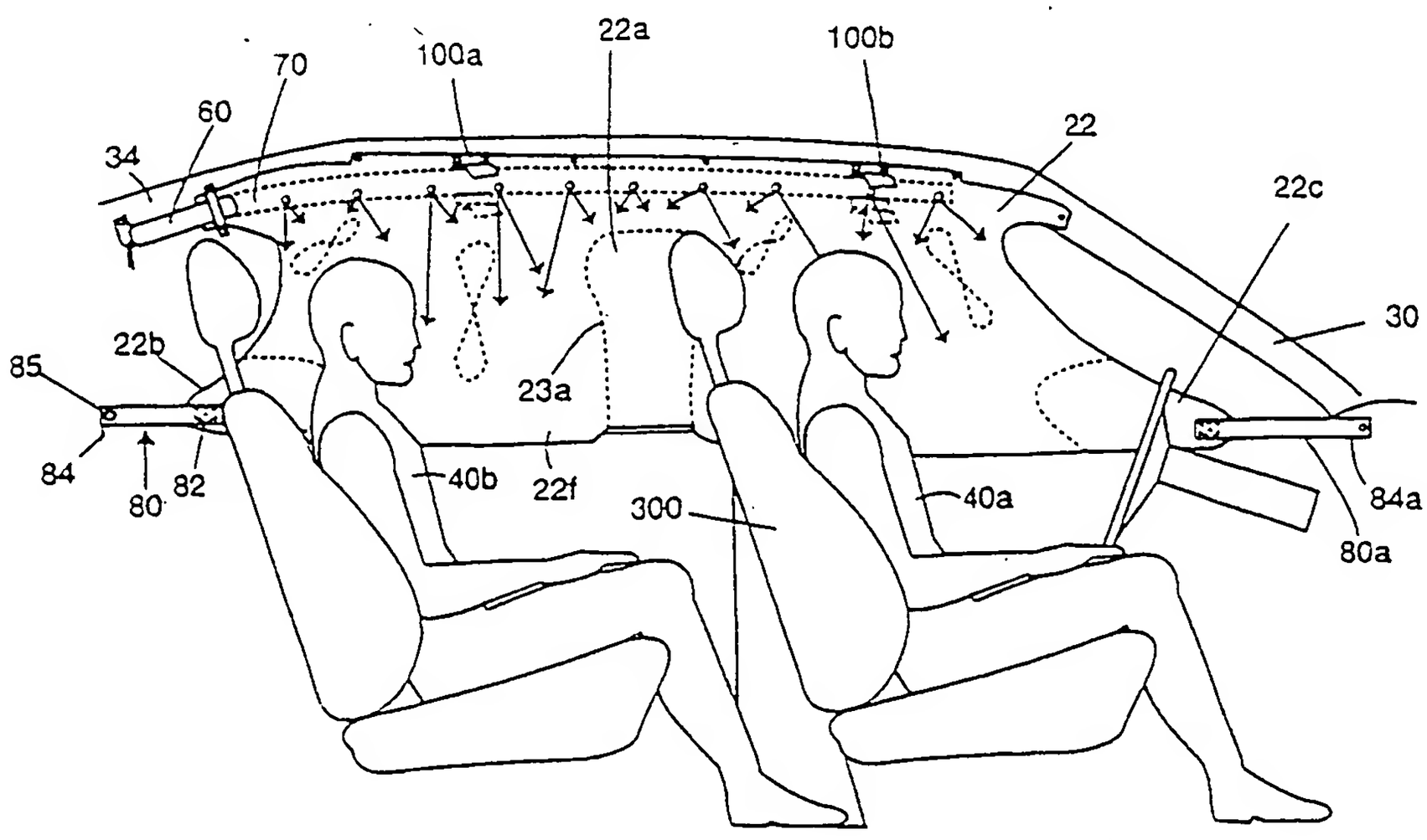
(72) Inventors: BAILEY, Brian, J.; 40664 Firesteel Drive, Sterling Heights, MI 48313 (US). TOBIAN, Robert; 48571 Sugarbush Road, New Baltimore, MI 48047 (US). JOST, Stefan; Johannisbergerstrasse 1, D–65197 Wiesbaden (DE). WONG, Samuel; 5495 Marina Drive, Troy, MI 48098 (US). WIPASURAMONTON, Pongdet, P.; 311 Elm Street, Rochester, MI 48307 (US). REUTER, Jorg; Schöne Aussicht 7, D–65527 Niedernhausen (DE).

(74) Agents: DRAYER, Lonnie, R.; Breed Automotive Technology, Inc., P.O. Box 33050, Lakeland, FL 33807–3050 (US) et al.

(81) Designated States: BR, CA, CZ, DE, ES, GB, JP, KR, MX, PL, RU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: SIDE CURTAIN AIRBAG SYSTEM



(57) Abstract

A side curtain airbag (72) extends from an A–pillar (30) across a B–pillar (32) and be secured proximate a C–pillar (34) of a vehicle. When inflated the airbag is of sufficient height to extend from proximate a roof rail (38) of the vehicle to at least the lower edge of a side window of the vehicle. The inflated airbag is disposed between the vehicle occupant and a side portion of the vehicle. A side curtain airbag module system further includes a flexible tube (70) having a plurality of openings along its length to distribute inflation gas to the airbag.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Larvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

SIDE CURTAIN AIRBAG SYSTEM

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to a side curtain airbag designed to provide protection to vehicle occupants during a side impact crash or rollover event. More particularly, the side curtain airbag module is mounted proximate the vehicle roof rail and concealed by the headliner trim. Upon impact, the side curtain airbag is deployed between the vehicle occupants and intruding object to protect the outboard front and rear occupants.

Accordingly the invention comprises a side curtain airbag system having an airbag of sufficient length to extend from an A-pillar across a B-pillar and be secured proximate a C-pillar of the vehicle, the airbag, upon inflation, is of sufficient height to extend from proximate a roof rail of the vehicle to at least the lower edge of a side window of the vehicle; the system further including a flexible tube having a plurality of distributed openings along its length to distribute inflation gas to the airbag and means for inflating the airbag.

It is an object of the present invention to provide an airbag or inflatable curtain to protect one or more vehicle occupants in a side impact or roll over crash event.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1a illustrates the major components of the present invention.

FIG. 1b shows a cross-sectional view taken through a portion of the airbag of FIG. 1.

FIG. 2 is a left-hand plan view of the interior of a passenger compartment showing the major components of the present invention.

FIG. 3 illustrates a cross-sectional view showing the interconnection of an airbag/cushion in relation to a roof rail.

FIG. 4 is an isometric view of an axial flow airbag inflator.

FIG. 5 illustrates the interconnection of the inflator with other components of the invention.

FIG. 6 shows a side curtain or airbag in its deployed state protecting occupants within the passenger compartment.

FIGS. 7 and 8 illustrate alternate embodiment of the invention.

FIG. 9 shows an alternate installation of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Reference is now made to Figs. 1a, 2 and 6. FIG. 1a illustrates a side curtain airbag module generally shown as 20. As used herein and in the claims, terms such as "top", "bottom", "upper", "lower", "front" and "rear" are understood to refer to locations viewed from the interior of a vehicle in which a side curtain airbag module is installed.

As best shown in FIG. 2, the side curtain airbag module 20 comprises an airbag 22 of sufficient length to extend generally from the vehicle's A-pillar 30 across the B-pillar 32 to the C-pillar 34. As illustrated in FIGs. 2and 6, when inflated the airbag is of sufficient height to extend from proximate a roof rail (38) of the vehicle to at least the lower edge of a side window of the vehicle. Put another way, the airbag 22 is of sufficient height such that when deployed the airbag 22 will be located between the side panels 36a and 36b of the vehicle and the upper torso of the outboard seated occupant, generally shown as 40a and 40b in FIG. 6).

The airbag 22 comprises a plurality of sewn panels 24a, 24b of woven airbag fabric or panels of thermoplastic material that are welded or bonded together. With regard to the fabric, airbag material permeability is chosen to match the required time that the airbag should be inflated. The top 26 of the airbag 22, proximate a seam 28 of the sewn panels 24a, 24b includes a plurality of openings 40. A plurality of fasteners, (not shown), are used to secure the top 26 of the airbag 22 to the reinforced roof rail 38 (see FIG. 3). As best seen in FIG. 1a, one end of the airbag, such as the left, rear end 42a of airbag 22,

includes an opening 44. Inserted within this opening 44 is an airbag inflator 60. In the embodiment shown, the inflator 60 includes a plurality of mounting brackets or flanges 62a and 62b to permit the inflator 60 to be mounted to an adjacent structural component such as the C-pillar of the vehicle. The inflator 60 may be a solid propellant, hybrid, augmented or liquid inflator of known variety, which upon activation produces, or supplies, pressurized inflation gas to the airbag 22. In the embodiment illustrated, the inflator 60 includes a plurality of axially oriented output ports 64. Located within the top portion 26 of the airbag 22 is a flexible tube 70. In the preferred embodiment of the invention the tube 70 has an elastomeric inner tube with a reinforced outer sheath made of a braided or woven fabric. Alternatively, the tube can be made of metal, plastic, rubber or nylon. The tube 70 includes a plurality of openings 72 located along its length. The tube 70 includes ends 74a and 74b. As can be seen in FIG. 5, one end 74a of the tube is secured about the inflator 60, which is a source of inflation gas, by a bracket 62b, to permit the inflation gasses to flow directly into the tube. The opposite end 74b of the tube is closed or bonded shut. It should be appreciated that the inflator 60 can be mounted to an end 74b of the tube which would require that end 74a be similarly closed. In addition, as can be appreciated, upon activation of the inflator 60 inflation gasses will be propelled through the tube 70. Because of the length of the tube 70 the pressure distribution of the inflation gasses will diminish in relation to the distance from inflator 60. Consequently, the openings 72 in the tube 70 may be non-uniformly distributed along the

length of the tube such the entire volume of the airbag 22 is inflated substantially simultaneously. As can be seen in FIG. 1a, the distribution of the openings 72 in the tube is biased toward the closed end 74b of the tube 70, that is the side of the airbag 22 farthest from the inflator 60.

As mentioned above, the airbag 22 comprises a plurality of joined panels 24a, 24b. The center 22a of the airbag, which is located near the seat back 300 of a front seat of the vehicle or alternatively near the B-pillar 32, is bonded or sewn shut so that it will not be inflated. The bonding or seam line is shown as 23a in FIG. 6. As can be appreciated, if the airbag 22 were inflated in this location 22a, it would not provide any measurable degree of occupant protection. The lower rear region 22b of the airbag 22 is similarly bonded or sewn together such that it does not inflate. In addition, this area may be reinforced to enable the connection of a tether 80 thereto. One end 82 of the tether is bonded or sewn to the lower rear region 22b of the airbag while another end 84 of tether 80 is loosely or pivotably secured to a structural portion of the vehicle by a fastener which is received through an opening 85 in the tether. Similarly, a lower forward region 22c of the airbag 22 is closed so that it does not inflate and a second tether 80a is secured thereto. Similarly, an end 84a of tether 80a is secured proximate a lower portion of the A-pillar 30 to permit it to rotate downwardly upon deployment of the airbag. Various other regions of the airbag, such as indicated at 22d and 22e in FIG. 1a, are sewn or bonded closed so that they do not inflate and channel the inflation

gas to specific inflated regions, lobes or portions of the airbag 22.

Beginning at a lower edge 22f of the airbag is folded into an accordion pleat configuration 90 to achieve the configuration generally shown in FIG. 3. In this folded configuration the airbag 22 will essentially be formed into a long, tubular-like configuration. To keep the airbag in this folded configuration, the airbag is enveloped in a breakable, or tearable, material such as shrink-wrap material (cellophane) 92 of a known variety. The folded, enveloped airbag 22 is then secured to the roof rail 38 using a plurality of fasteners, such as retainer clips 100a, 100b. As illustrated in FIG. 3, one of the retainer clips 100b includes a pre-stressed tear region 102 to permit each clip to tear open (as illustrated in FIG. 6) upon inflation of the airbag. The retainer clips 100a and 100b can be secured by fasteners 110 as illustrated in FIG. 3 to the roof rail.

As is known in the art, located above the front and rear doors of many vehicles are U-shaped grab handles that are utilized to assist the occupant in exiting the vehicle. One such grab handle 112 is illustrated in FIG. 3. The fastener 110 utilized to secure the grab handle to the roof rail can also be utilized to secure the clips 100a, 100b to the roof rail. As can be appreciated, the number of clips will depend on the individual vehicle. In addition, the folded, enveloped airbag can be placed in a tubular plastic shell having the pre-stressed section 102; in essence the pre-stressed shell can be envisioned as a plurality of contiguous retaining clips 100a,b, etc.

Reference is briefly made to FIG. 7 that illustrates an alternate embodiment of the invention. In this embodiment the inflator 60a is configured such that it comprises at least two exit ports 64a and 64b (opposite to one another). The inflator, using an adapter 150, is secured to opposing sections 70a, 70b of a segmented tube 70. The inflator 60a of FIG. 7 can be secured to the B-pillar 32 of the vehicle.

FIG. 8 illustrates another alternate embodiment of the invention. In this embodiment, the inflator 60b comprises axial flow ports 64 at both of its ends. The inflator is connected to opposing sections 70a, 70b of the segmented tube 70.

Reference is briefly made to FIG. 9 which illustrates a further embodiment of the invention. FIG. 9 shows a top plan view of a roof of a vehicle. The front windows 200 identify the forward portion of the vehicle. Many vehicles, such as vans and trucks, include a center console 202 located in front of and between the seating locations of the front occupants of the vehicle. Located generally in the area of this console is a central inflator 60 that is in communication, via tubes or conduits 202a, 202b, with a section proximate the closed end 74b of opposing situated cushions 22. The opposing end 74a of each of the cushions 22 is enclosed. Situated within each conduit 202a, 202 b is a control valve 204a, 204b that is responsive to signals received from a control unit 206. The control unit is responsive to input signals 208 received from a plurality of crash sensors (not shown) located in and about the vehicle. Upon sensing that the vehicle is involved in a crash on one or the other side of the vehicle, or that the vehicle is

involved in a rollover, the controller 206 activates the inflator 60 and one of the corresponding control valves 204a, 204b to permit inflation gas to flow to one or the other of the airbags 22 on the right or left-hand side of the vehicle in the side impact and/or rollover crash event. Alternatively, and depending upon the capacity of the inflator 60 of FIG. 8, the control unit 206 may simultaneously activate both valves 204a, 204b which will then deploy the airbags 22 on both sides of the vehicle such that they achieve the deployed orientation illustrated in FIG. 6.

CLAIMS

1. A side curtain airbag system (20) comprising:

an airbag (22) comprising a plurality of joined panels (24a, 24b) and being of sufficient length to extend from an A-pillar (30) of a vehicle to be secured proximate a C-pillar (34) of a vehicle, when inflated the airbag is of sufficient height to extend from proximate a roof rail (38) of the vehicle to at least the lower edge of a side window of the vehicle;

a flexible tube (70) located in the airbag and having a plurality of openings (72) along its length to distribute inflation gas to the airbag; and

a source of inflation gas (60) communicating with the flexible tube for inflating the airbag.

2. The side curtain airbag system (20) of claim 1 wherein the openings (72) in the flexible tube (70) are non-uniformly distributed along the length of the tube such the entire volume of the airbag is inflated substantially simultaneously.

3. The side curtain airbag system (20) of either of claims 1 or 2 wherein a lower rear region 22b of the airbag 22 is bonded or sewn together such that it does not inflate.

4. The side curtain airbag system (20) of any of the preceding claims wherein a lower front region 22b of the airbag 22 is bonded or sewn together such that it does not inflate.

5. The side curtain airbag system (20) of any of the preceding claims wherein various regions of the airbag (22d and 22e) are bonded or sewn together such

that they do not inflate and thereby channel the inflation gas to specific inflated regions of the airbag.

6. The side curtain airbag system (20) of any of the preceding claims wherein beginning at a lower edge (22f) of the airbag the airbag is folded into an accordion pleat configuration (90) to essentially be formed into a long, tubular-like configuration and is enveloped in a breakable, or tearable, material.

7. The side curtain airbag system (20) of Claim 6 wherein the folded, enveloped airbag (22) is secured to the roof rail (38).

8. The side curtain airbag system (20) of any of the preceding claims wherein the tube (70) has an elastomeric inner tube with a reinforced outer sheath made of a braided or woven fabric.

9. The side curtain airbag system (20) of any of the preceding claims wherein the tube (70) has one end (74a) that is secured about an inflator 60 that is the source of inflation gas to permit the inflation gas to flow directly into the tube, an opposite end (74b) of the tube being closed or bonded shut.

10. The side curtain airbag system (20) of any of Claims 1 through 8 wherein the tube has two ends which are closed or bonded shut and the source of inflation gas supplies inflation gas to the tube at a location intermittent of the two closed ends.

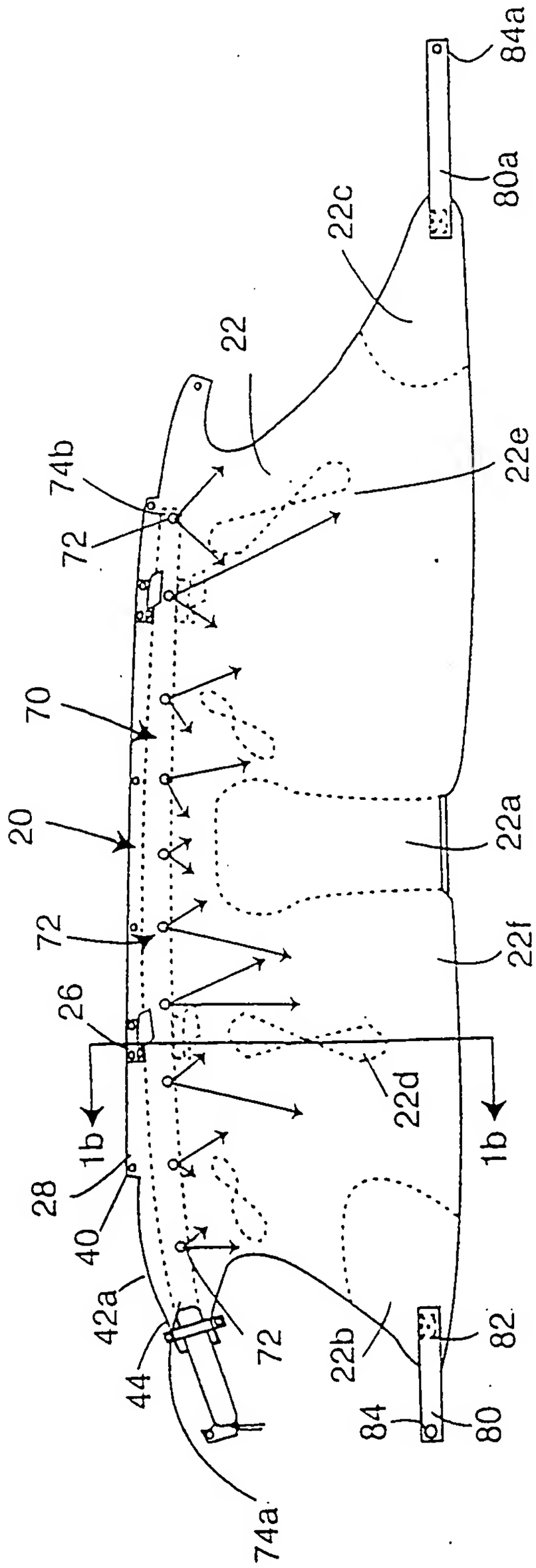

84a
80a
22c
22
74b
72
22e
70
20
72
22a
22f
26
22d
1b
28
40
42a
44
72
74a
22b
82
84
80
1b

Fig. 1a

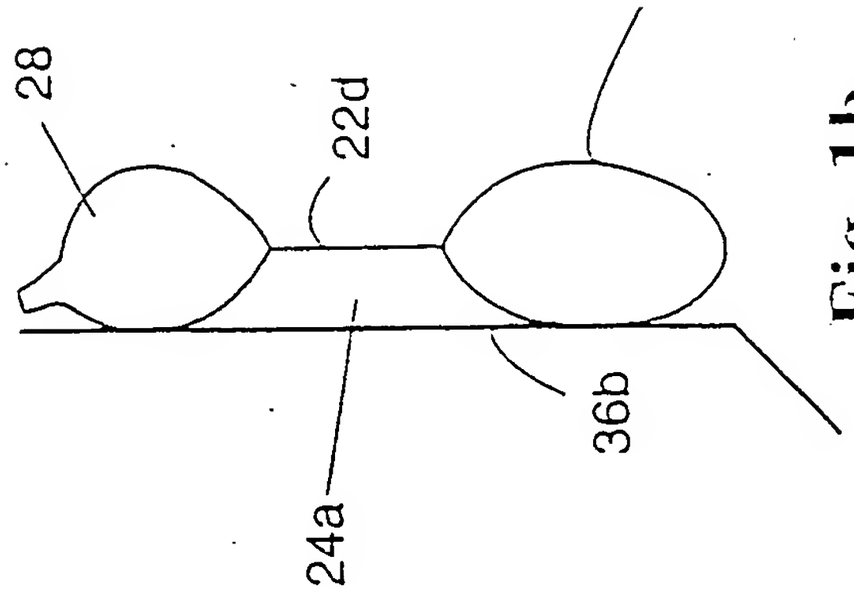

28
22d
24b
24a
36b

Fig. 1b

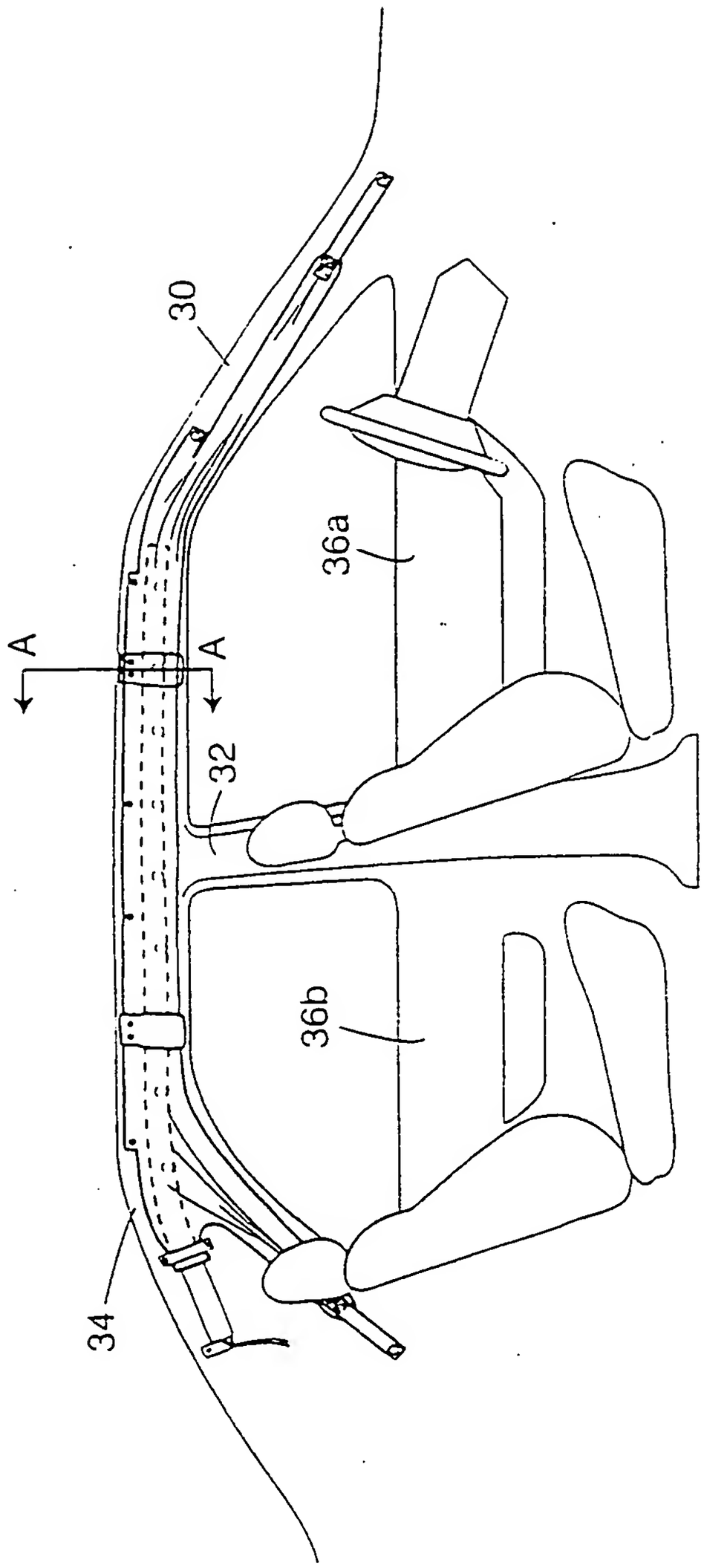


Fig. 2

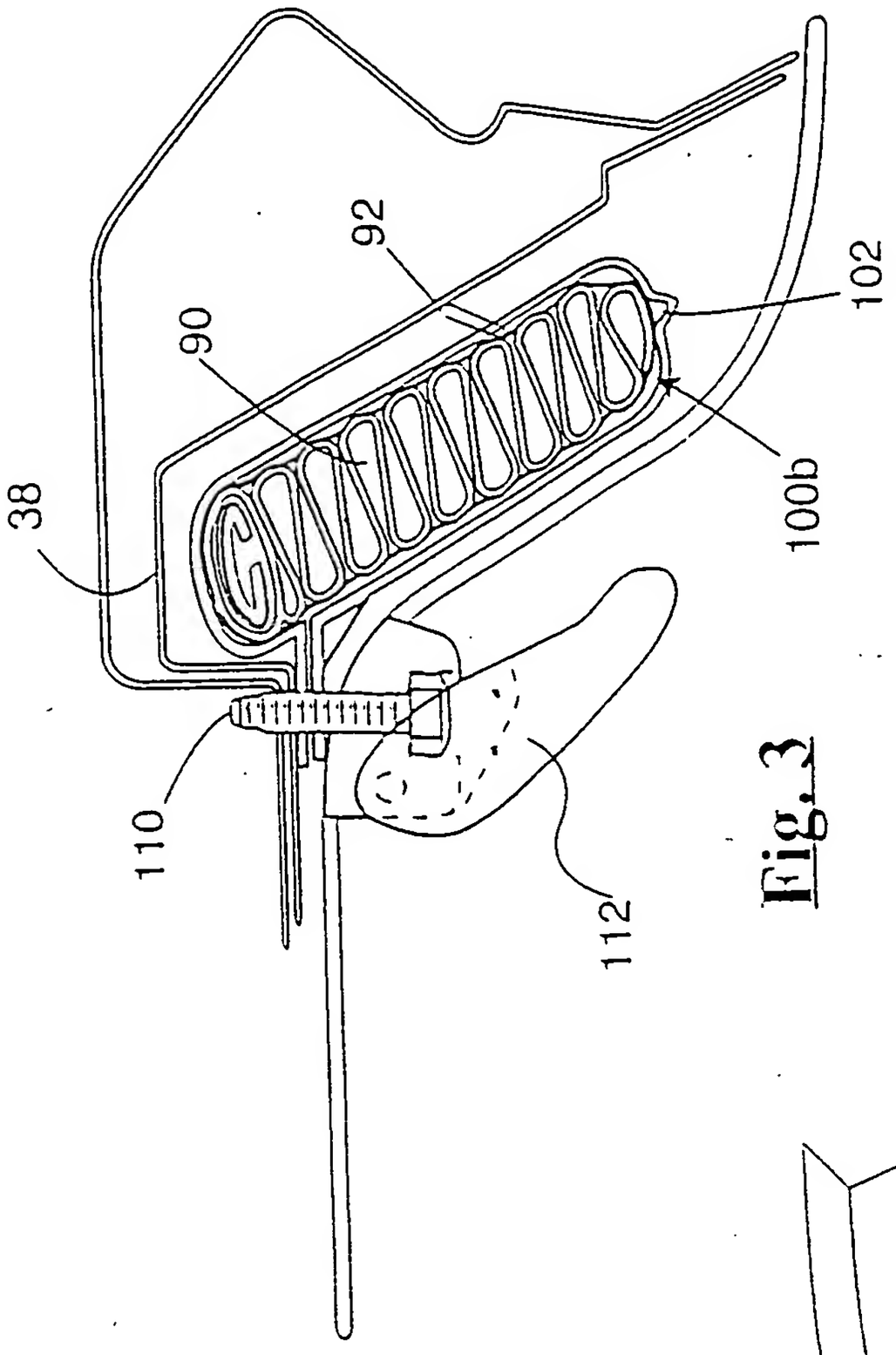


Fig. 3

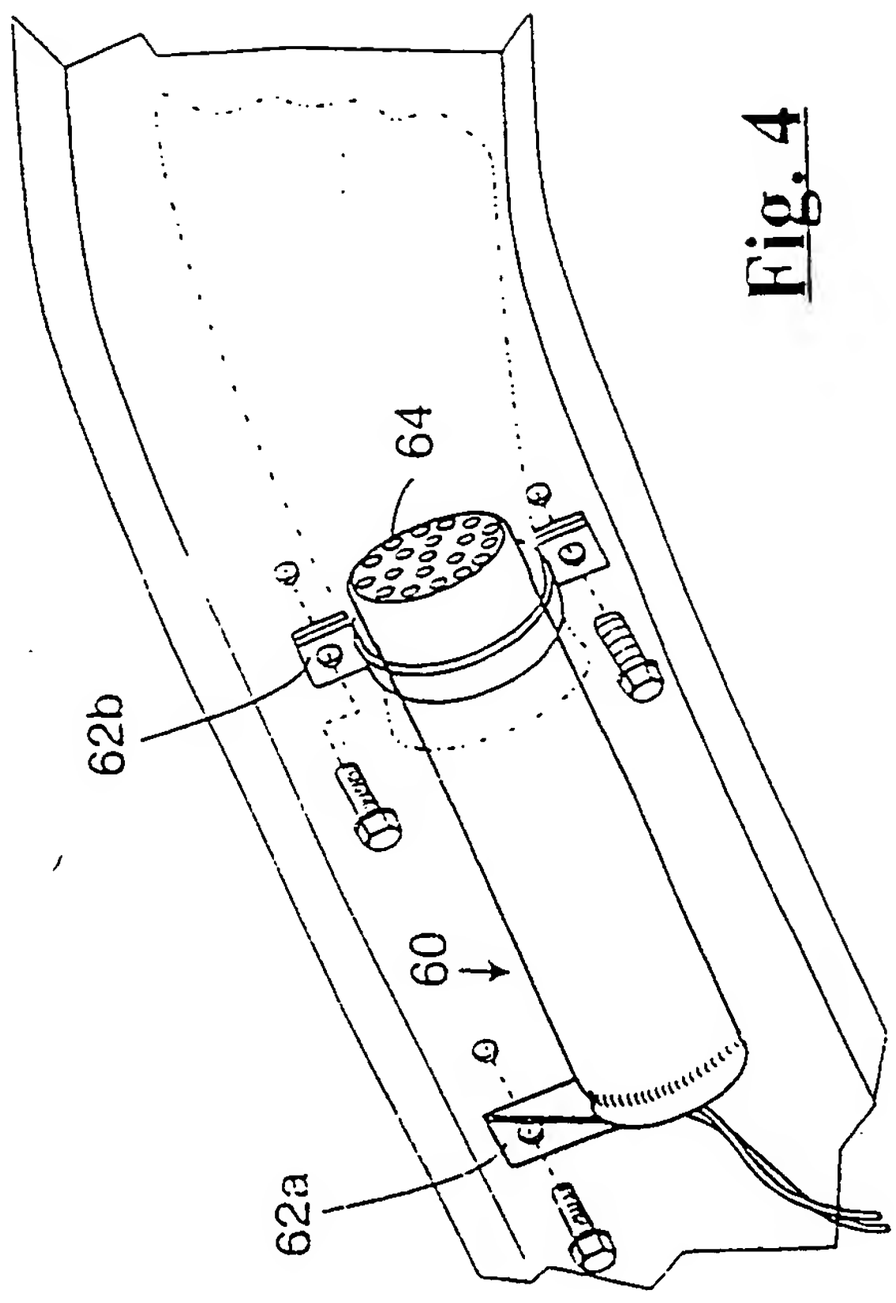


Fig. 4

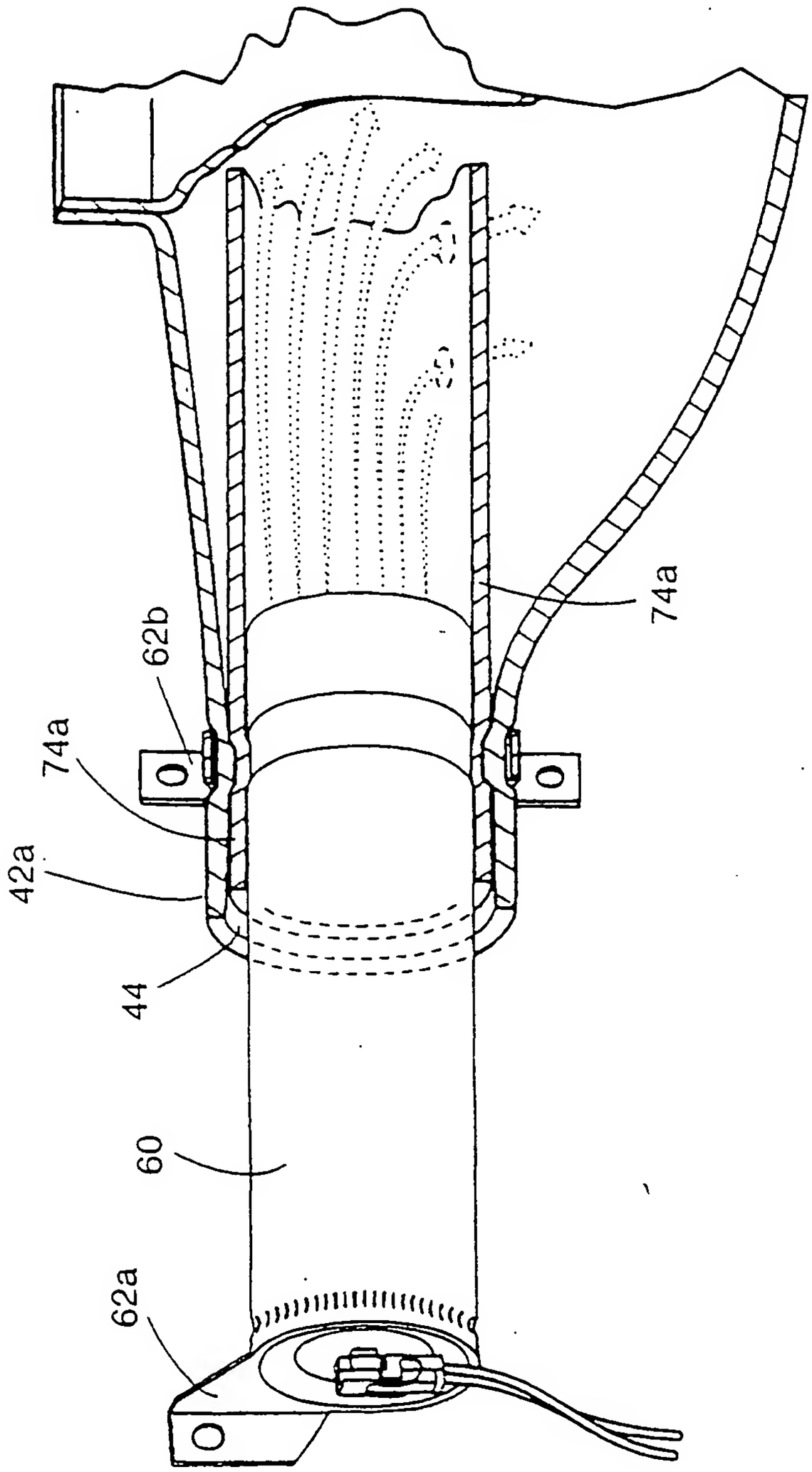


Fig. 5

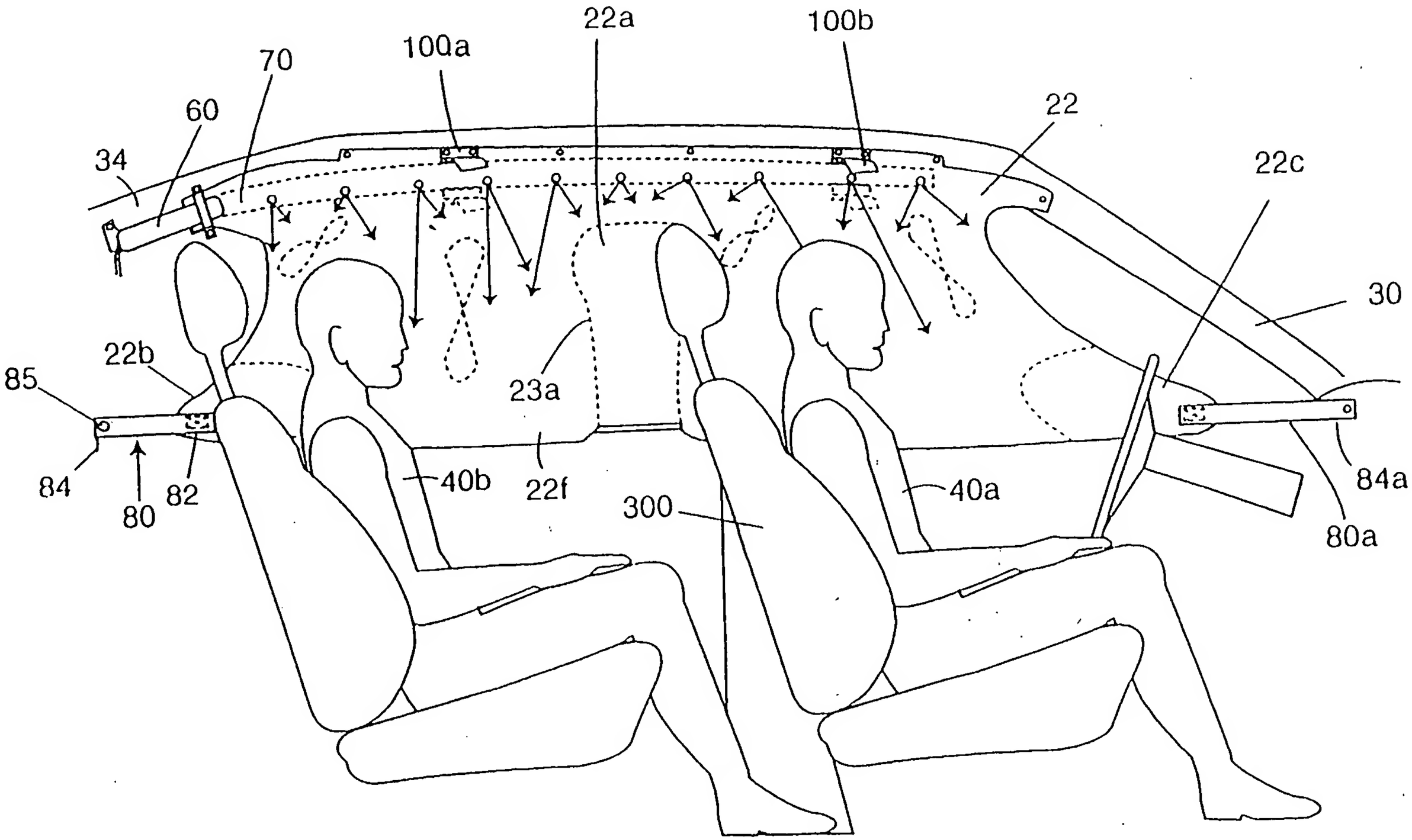

22a
100b
100a
70
60
34
22
22c
30
22b
85
23a
84
80
82
40b
22f
300
40a
84a
80a

Fig. 6

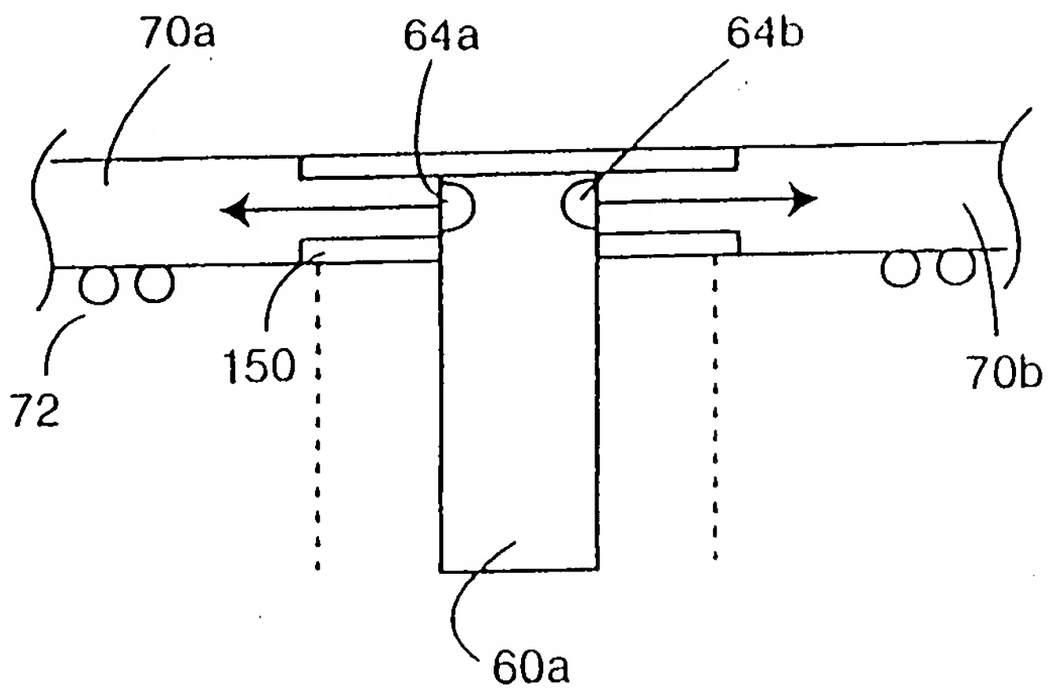


Fig. 7

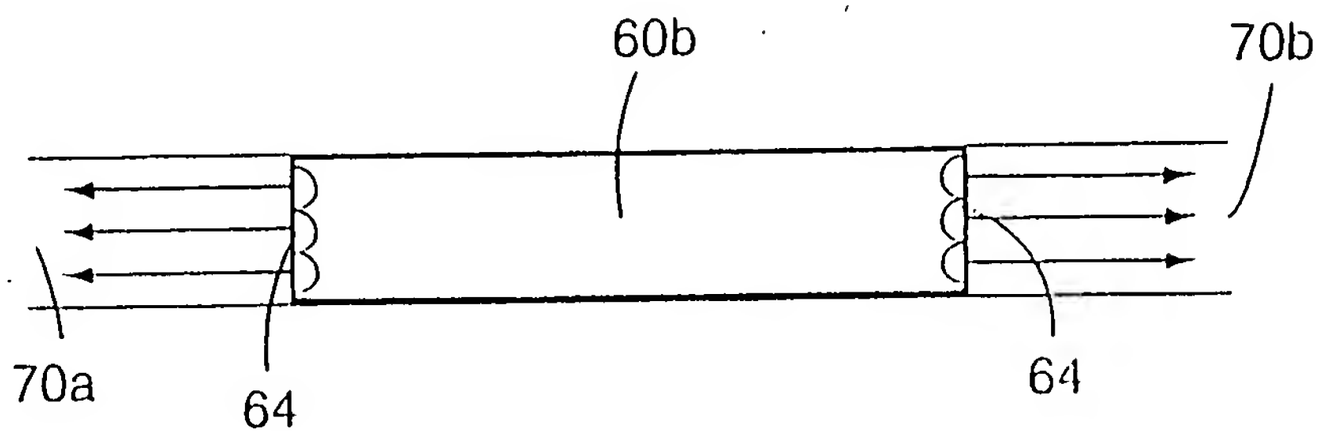


Fig. 8

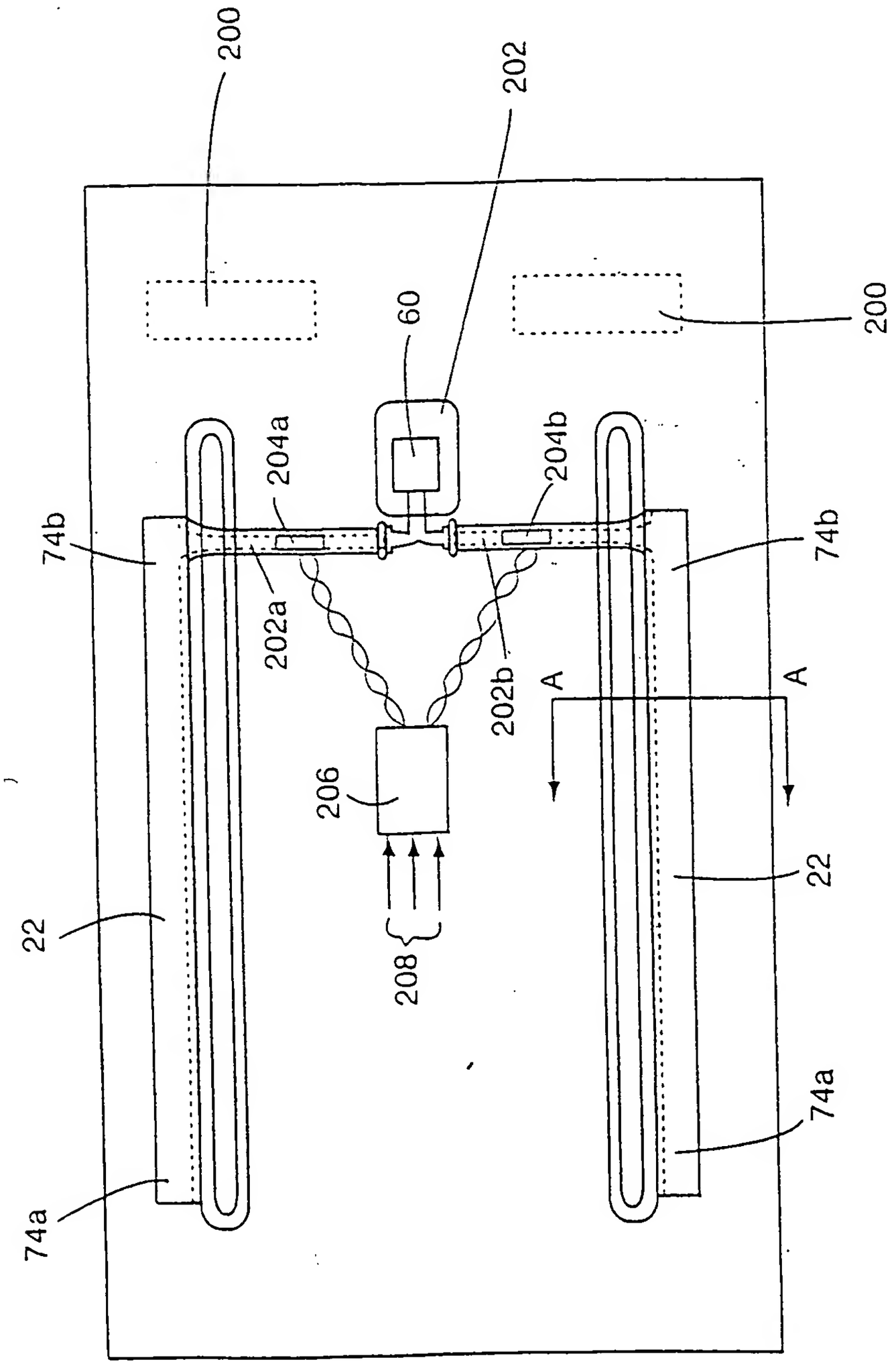

200
202
200
60
204a
204b
74b
74b
202a
202b
A
A
206
208
22
22
74a
74a

Fig. 9

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/00508

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B60R21/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 314 300 A (AUTOLIV DEV) 24 December 1997 see figures see abstract see page 4, line 12 - page 9, line 16	1,3,4,6, 7,9
A		2,8
A	EP 0 814 001 A (HS TECH & DESIGN) 29 December 1997 see figures 1,5 see abstract see column 6, line 9 - line 52	1-9
P,A	GB 2 326 385 A (AUTOLIV DEV) 23 December 1998 see figures 5,6 see abstract see page 9, line 27 - page 11, line 13	1,5-7,10

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 April 1999	10/05/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	D'Silva, C

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/US 99/00508

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
P,A	GB 2 319 751 A (AUTOLIV DEV) 3 June 1998 see figures see page 4, line 28 - page 9, line 2	1,5-7,9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 99/00508

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2314300 A	24-12-1997	NONE	
EP 0814001 A	29-12-1997	DE 29610920 U	29-08-1996
		DE 29613781 U	26-09-1996
GB 2326385 A	23-12-1998	GB 2297950 A	21-08-1996
		AU 689706 B	02-04-1998
		AU 4852996 A	11-09-1996
		CN 1181040 A	06-05-1998
		EP 0808257 A	26-11-1997
		GB 2326384 A	23-12-1998
		WO 9626087 A	29-08-1996
		US 5788270 A	04-08-1998
		ZA 9601335 A	12-09-1996
GB 2319751 A	03-06-1998	WO 9822313 A	28-05-1998